To achieve such an object, according to an optical fiber of the present invention, in an optical field including a core region and cladding regions of not less than three layers which surround the core region in order, each of said cladding regions has a mean refractive index different from those of the adjacent regions, at least one of the cladding regions has lower mean refractive index than both adjacent regions, and at least one cladding region is provided with a plurality of sub medium regions each having a refractive index lower than a main medium constituting this cladding region.

a3

Replace the second paragraph at page 5, lines 4-13 with:

The fact that a certain region is constituted by a substantially homogeneous material implies that the region does not include microstructures and it may be possible to suitably adopt a constitution where the concentration of the impurity in a material which constitutes the region is varied within the region. For example, may adopt a constitution in which the region may be constituted by silica glass containing Ge as the impurity and the concentration of Ge is gradually decreased from the center to the outer periphery.

a4

Replace page 8, lines 1-25 with:

a5

It is preferable that the ratio of the optical power which propagates through the microstructures of the outer cladding region to the total optical power propagating through said optical fiber is set to not more than 1 %. This is because when the optical power which propagates through the microstructures of the outer cladding region is increased, the optical fiber becomes more vulnerable to the excess optical loss caused by

impurities in the microstructures, and such a provision reduces an excess transmission loss and makes the optical fiber robust to such impurities.

It is preferable to operate the optical fiber in a single mode at a given wavelength between 1510nm to 1590nm since the inter-mode dispersion can be eliminated and hence, it becomes possible to use the optical fiber for the transmission of the optical signal of high bit rate.

a5

By setting the chromatic dispersion at a given wavelength between 1510nm to 1590nm to a value below -80 ps/nm/km, the length of the optical fiber necessary for compensating for the positive chromatic dispersion can be shortened. When the optical transmission path is constituted by combining this optical fiber and an optical fiber having the positive chromatic dispersion at a given wavelength, an optical fiber transmission path having the small cumulative chromatic dispersion and capable of performing a large capacity communication can be realized.

Replace at page 19, lines 2-23 with:

a6

Fig. 8 shows the calculated result of the comparison between the example 1 and the comparison examples 1, 2 with respect to the structural chromatic dispersion D_{wg} and the effective core area A_{eff}. In Fig. 8, the structural chromatic dispersion D_{wg} is taken on the axis of the left-side ordinates, the effective core area A_{eff} is taken on the axis of the right-side ordinates and the optical wavelength λ is taken on the axis of abscissa. Here, in all of the example 1 and the comparison examples 1, 2, the pitches L are set such that the structural chromatic dispersion D_{wg} at the wavelength of 1550 nm becomes equal -100 ps/nm/km. That is, the values of the pitches L are respectively set to 1.66 μm in the

example 1, 1.62 μ m in the comparison example 1 and 1.48 μ m in the comparison example 2. The structural chromatic dispersion slope at the wavelength of 1550 nm is - 0.5 ps/nm^2/km in the example 1 and the comparison example 1 and this value is smaller than - 0.2 ps/nm^2/km which is the structural chromatic dispersion slope if the comparison example 2. However, in the example 1, the effective core area is set to 8.3 μ m^2 and this value is larger than 7.7 μ m^2 which is the effective core area of the comparison example 1.

a6

Replace at page 27, lines 18-26 through entire page 28 and page 29, lines 1-8 with:

a7

Fig. 15 is a graph showing the ratio of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) and the ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P) in the comparison example 3 and examples 4 to 6 in a comparison form.

In the examples 4 to 6, by introducing voids as the sub mediums 15 into the outer cladding region 13, the ratio of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) is reduced compared to the comparison example 3.

On the other hand, this ration of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) has the positive correlation with the bending loss. Accordingly, by introducing voids into the outer cladding region 13, an advantageous effect that the bending loss is reduced can be

obtained. Accordingly, a highly reliable transmission path having low transmission loss can be realized.

Further, the ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P) is set to not more than 10^{-6}. This contrasts remarkably with the fact that the conventional optical fiber having microstructures has the large ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P). For example, as shown in Fig. 16, in the conventional optical fiber having microstructures where voids having a diameter of 0.68 μ m are arranged in silica glass at a pitch of 1.7 μ m, the ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P) at the wavelength of λ = 1550 nm is 0.039 which is 10^4 times larger than that of the optical fiber of this embodiment. This large ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P) has been the factor for generating an excess optical loss. To the contrary, in the optical fiber according to this embodiment, since the ratio of optical power which propagates through void to the total optical power propagating through said optical fiber is small, the possibility that the excess optical loss is generated can be reduced and the sensitivity of the chromatic dispersion characteristics to the shape of voids can be also reduced whereby the demand for the fabrication technique can be alleviated.

Replace page 32, lines 25-26 through page 33, lines 1-14 with:

a8

Fig, 20 is a view showing the ratio of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) and the ratio of optical power which propagates through void to the total optical power propagating through said optical fiber (P_{air}/P) in the comparison example 3 and examples 6, 6a, 6b in a comparison form. Although the examples 6a, 6b exhibit the larger ratio of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) than the example 6, the examples 6a, 6b exhibit the smaller ratio of optical power which propagates through a jacket region to the total optical power propagating through said optical fiber (P_{jacket}/P) than the comparison example 3. That is, the examples 6a, 6b can simultaneously achieve the large chromatic dispersion to negative, the large chromatic dispersion slope to negative, the large effective core area and the small bending loss compared with the comparison example 3.

IN THE CLAIMS:

Please amend clams 1, 8, 9 and 10 as follows:

a9

1. (Amended) An optical fiber including a core region and cladding regions of not less than three layers which surround said core region in order, wherein

each of said cladding regions has a mean refractive index different from those of the adjacent regions, at least one of said cladding regions has a lower mean refractive index than both adjacent cladding regions, and at least one cladding region is provided with a plurality of sub medium regions each having a refractive index lower than a main medium constituting this cladding region.